Developing a model for a lead-focused health fair in Chicago communities

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Introduction [*]

The health effects of low-level lead exposure range from neurological, immune, renal, reproductive, and developmental effects (National Toxicoloy Program, 2012). Adverse health effects of lead in children include neurological effects such as behavioral and intellectual deficiencies (Agency for Toxic Substance and Disease Registry, 2007a). According to the National Toxicology Program, there is 'sufficient' evidence to show that adverse health effects occur at blood lead levels (BLL) as low as 5 micrograms per deciliter (μg/dL) (National Toxicoloy Program, 2012). Because of this, there is no 'safe' exposure to lead for vulnerable populations such as children and pregnant women (Agency for Toxic Substance and Disease Registry, 2007b).

Lead is a naturally occurring heavy metal that is used in a variety of products including paint, pipes, batteries, and previously in gasoline (Agency for Toxic Substance and Disease Registry, 2007b). Further, waste incineration, utilities, smelting operations, and certain manufacturing operations emit lead into the air (Environmental Protection Agency, 2017). Additional airborne emission sources of lead can be generated from petcoke, a by-product of coal processing, stored near residential areas (Caruso, Zhang, Schroeck, McCoy, & McElmurry, 2015). Environmental exposures can be found in the air, food, water, dust, and soil (WIlliam L. Roper; Vernon N. Houk, 1991).

In Chicago, children are most at risk of exposure to lead through ingestion and inhalation of lead from paint dust generated in older homes (Chicago Department of Public Health, 2016). In the United States, of the over two and a half million children tested for lead, 4.25% had BLL equal to or greater than the Environmental Protection Agency's (EPA) action level of 5 μg/dL and Illinois was ranked the 8th highest state with 5.98% of children testing at elevated BLL (Shah, Oleske, Gomez, Davidow, & Bogden, 2017).

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In Chicago, 3.5% of children under the age of 3 that were tested, had elevated BLL (Chicago Department of Public Health, 2016). In addition, children living in older housing had significantly higher odds of having elevated BLL as did children of lower income (McClure, Niles, & Kaufman, 2016). Children living in Chicago's Southside, Westside, and Far Southside had significantly higher odds of elevated BLL with an odds ratio of 2.45, 3.29, and 2.12, respectively (Tonny J. Oyana, 2010). Further, the Austin neighborhood and surrounding areas had some of the highest percentages of children with elevated BLL in the city ranging between 4.1% and 10.1% (Chicago Department of Public Health, 2016). These 'lead hotspots' can be attributed in part to the relatively high percentage of pre-1950's housing (Tonny J. Oyana, 2010).

The objective of this project was to address these health disparities by conducting a health fair in the Austin neighborhood in which DePaul faculty researchers partnered with a community health organization to provide educational information and resources to the community. Specifically, the aims of the health fair were (1) to assess community exposures to lead in soil and water, (2) to survey health behaviors and knowledge and provide information to the community about lead in their environment and the potential health effects, and ways to control and minimize the associated health effects, and (3) to develop and pilot an effective model for a community based health fair focused on lead as an environmental health issue.

Methods

The health fair was conducted by DePaul University and held at Broader Urban Involvement & Leadership Development (BUILD), a non-profit organization serving Chicago's south and west sides with the goal of providing youth opportunities, mentoring, and activities 'so they can realize their educational and career potential and contribute to the stability, safety and well being of our communities' ("www.buildchicago.org," 2017). This partnership between BUILD and DePaul was developed to increase BUILD's capacity to provide health education and resources to the community. Recruitment was conducted through BUILD's membership outreach and the health fair was held in conjunction with BUILD's regular 'Family Night' on Friday June 9 to maximize participation. DePaul students were on site to register community members and answer any questions (Figure 1).

Figure 1: DePaul students at the registration table.
Photo courtesy of James Montgomery.

Community members were incentivized to participate through entry into a raffle and the opportunity to have their soil and water testing results provided on site.

Measurements of lead concentrations in soil and water were conducted and health behavior and knowledge were surveyed for those participants that were 18 years or older. Lead concentration in soil was measured using a pXRF, a portable spectrometer from Thermo Scientific Portable Analytical Instruments (Tewksbury, MA) with a detection limit of approximately 20 parts per million (ppm). Collection and analysis of soil samples followed the protocols set by the Agency for Toxic Substances and Disease Registry (ATSDR) for their Screening-Health-Outreach-Partnership (soilSHOP). The soilSHOP protocol is designed to 'help people learn if their soil is contaminated with lead, and how to reduce exposures to contaminated soil and produce'(Agency for Toxic Substance and Disease Registry, 2016). Laboratory technicians Bill Schierven and Sara Schierven conducted the pXRF analyses as did Health Sciences' James Montgomery (Figure 2 and 3).

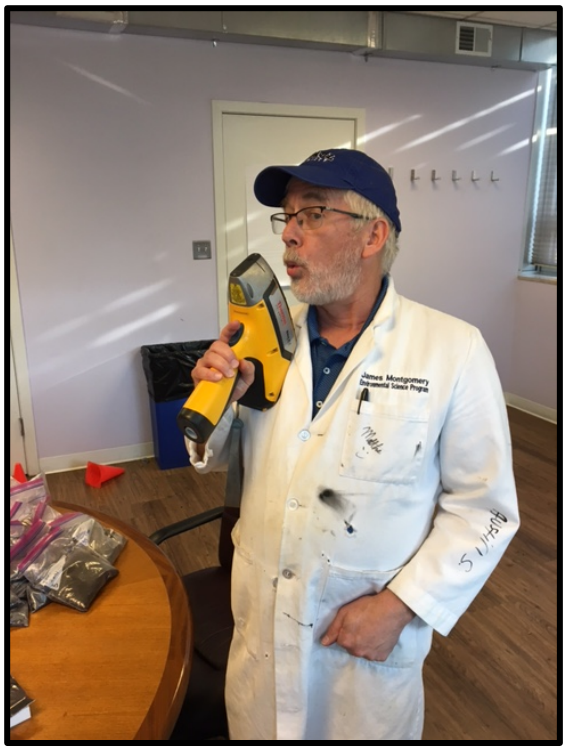
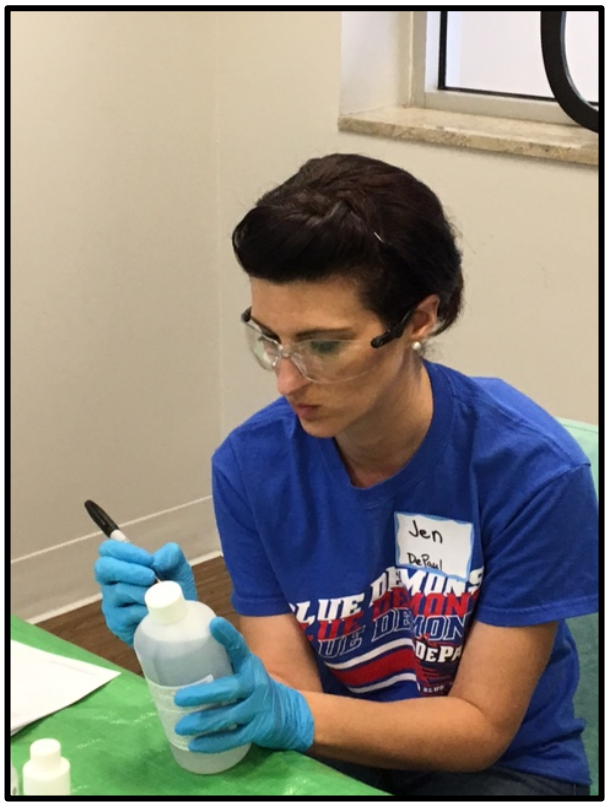


Figure 2 and 3: Bill and Sara Schjerven using the p-XRF to measure lead concentrations in soil samples. Dr. James Montgomery is quick on the draw with the p-XRF! Photos courtesy of James Montgomery.

Lead concentration in water was measured using a LeadTrak portable colorimeter from Hach (Loveland, CO) with a limit of detection of 1 part per billion (ppb). Water testing was conducted by four DePaul undergraduate environmental science and studies majors – Jen Thompson, Alli Preble, Erik Espeland, and Azalea Rudolph (Figures.



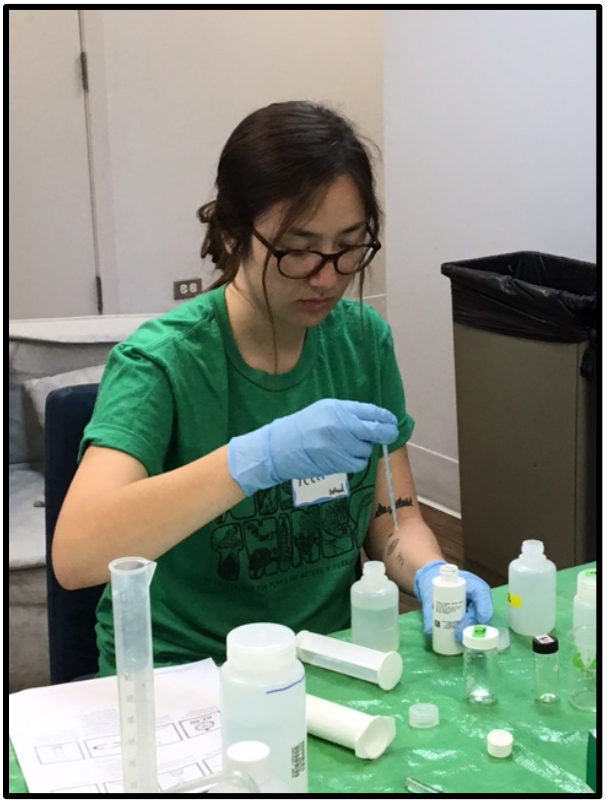


Figure 5 and 6: Environmental Sciences majors using the Hach LeadTrak-II test kit to analyze tap water samples. Photo courtesy of James Montgomery.

Instruments were calibrated on-site prior to use. Both measures were used as screening only and not intended as regulatory compliance assessment. Standardized regulatory level follow-up measurements were recommended for any samples found to be above the level of concern of 15 ppb in water based on the Lead and Copper Rule and 400 ppm in soil as recommended by the EPA for a child's play lot (Environmental Protection Agency, 2017).

Health behavior and knowledge of lead exposure, health effects, and control information was assessed in a self-administered survey. The survey also contained demographic questions and information on the participants' living conditions. The thirty-nine-question survey consisted of multiple choice and short answer questions. Information was also collected about the location and sampling method for soil samples to identify any potential contributing factors.

Eight health educators from Health Sciences, Environmental Sciences, and the Master of Public Health Program were trained by Camille DeMarco to deliver health information to community members through a train-the-trainer model (Figure 7).

Figure 7: Master of Public Health Program students and professor delivered health information to the community and conducted a survey. From left- Kaitie Badalamenti, Camille DeMarco, Julia Lippert, Lauren Ebeling. Photo courtesy of James Montgomery.

Results

Twenty-six soil samples and 33 water samples were analyzed during the health fair. The soil samples ranged from below detection limit to a maximum concentration of 1849 ppm. Four samples tested above the level of concern. The water samples ranged from below the limit of detection to greater than 150 ppb, with 4 samples above the level of concern.

Participants completed a total of twelve surveys. All of the participants were employed and had at least one year of college education. The annual household income ranged from $15,000 to $19,999 on the lower limit and $70,000 to $79,999 on the upper limit. Three quarters of participants rented their homes. Approximately one third of survey respondents were Latino or Hispanic and one third were Black or African American. None of the participants reported living near a factory that used lead, however 5 of the 12 respondents reported living in a home built before 1978. Half of respondents did not wear shoes in the home (n=6) and two thirds of participants used some sort of water filtering device (n=8).

Overall, respondents reported knowledge of lead, associated health effects, and control or testing resources between fair and good ($\bar{X}$=2.51$\pm$1.15). Half of the respondents reported that they had poor knowledge about testing for lead in soil (n=6). More than half of respondents reported that had poor knowledge of handling produce grow in lead contaminated soil (n=7) and the majority of respondents reported poor (n=6) or fair (n=4) knowledge of how to minimize health effects associated with contaminated soil. All respondents expressed interest in learning more about soil testing and safe gardening techniques.

Results from the soil and water testing that was completed on site were communicated with participants directly or with BUILD representative Jessica Carrillo. Testing results that were generated after the fair were communicated through a final report to Jessica Carillo. All of the participants that tested above the level of concern had a meeting with a health educator under the guidance of Dr. Julia Lippert and Camille DeMarco from DePaul's Masters of Public Health Program. During the meeting the health educator explained the results of the test, directed the participant to where they can get regulatory level follow-up testing, and gave the participants water filtering pitchers and information on how to control soil exposures of lead. Health education was also shared with any interested community members and demonstrations of analysis were performed throughout the health fair for interested youth and community members.

Discussion

The results of the testing were consistent with what was expected of samples collected in an urban environment. Three of the four soil samples with elevated lead levels were marginally elevated above the EPA's threshold for children's play lots (Environmental Protection Agency, 2017). One of the samples had levels of 1849 ppm. Samples were collected from various locations from participant's yards, including native soil and gardens. The elevated levels of soil lead may be the legacy of lead-based exterior paint used on pre-1978 homes and/or deposition of lead aerosols resulting from automobiles burning leaded gasoline (phased out in the mid-1970s) and/or factory emissions.

The four water samples with elevated lead levels were substantially higher than the EPA's level of concern of 15ppb (Environmental Protection Agency, 2017). However since there is no reported 'safe' level of exposure to lead, the Environmental Defense Fund recommends a more protective level of 3.5 ppb when considering health effects (Neltner, 2017). In comparison to this level, the elevated samples

are magnitudes higher. These elevated levels may have occurred for a number reasons. Because the sample collection was performed with minimal instruction and no oversight, the samples may have collected in a way that would overestimate the average level throughout the day, such as taken during the first draw of water. Further, these levels may have been anomalies due to seasonal variations or construction performed in the area. These samples were intended as screening tools to determine which community members needed additional sampling, which was recommended.

Overall the Fair met the objectives of providing educational materials and resources to engage the community in activities related to environmental health and to educate community members about lead contamination. There was a sufficient turnout of participants due mainly to the fact that the Fair was held in conjunction with BUILD's *Family Night* event. Many of the participants who brought in soil and/or water samples remarked how grateful they were to receive free testing. And one of the most beneficial aspects of the Fair was the involvement of students and staff from DePaul's Department of Environmental Science and Studies, Chemistry, Health Sciences, and the Masters in Public Health Program. The students got to apply their respective disciplinary knowledge to a real community health issue.

Lead, as an environmental health concern, has received much press attention due in large part to the criminal nature of recent crises in Flint, Michigan and East Chicago. Until late, major industrial cities like Chicago have long suffered from lead contamination with a relative lack of media attention. And while low-income communities of color like Austin have borne the brunt of the contamination, lead contamination is still ubiquitous in all Chicago communities, including the most affluent ones. The results of this Fair suggest the need for a comprehensive investigation of lead contamination in the soil and water in additional Chicago communities. Although, this was a successful pilot of a community

based health fair conducted in the Austin neighborhood, there remain many areas of need within the city of Chicago and other urban settings. This model is recommended for future such health fairs.

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